Routing Attempt fails:

Any cause value not found in Table 1 shall be considered as a routing attempt failure.
If, on inspecting the Cause value in the ISUP REL message, QoR determines that the routing attempt did not succeed, QoR shall then

¥ restore the original route supplied by digit-analysis (which may or may not be a route to the donor switch), and
¥ direct the Originating Basic Call Model to resume processing within the Information Analyzed DP, at the point immediately following QoRŌs initiation. This applies to both the OCT and Originating Call Model triggers.

The call is expected to then either:

¥ encounter a Originating Call Model LNP trigger (on switches that support this implementation of LNP);
¥ encounter an IN LNP trigger (on switches that support this implementation of LNP); or
¥ terminate to an open NPA-NXX on switch and encounter a TAT-like LNP trigger (on switches that support this implementation of LNP).

LNP trigger and response processing shall proceed based on the requirements in FSD 30-12-0001:

¥ if the LNP response indicates that the Called DN has not ported[1] (i.e. does not contain an LRN), the switch shall route the call to the donor switch. In the ensuing ISUP IAM, the _Translated Called Number Indicator_ field of the FCI parameter shall be set to _Number Translated_, and the _Routing Attempt_ indicator shall be set to _no routing attempt in progress._

¥ if no response is received from the LNP SCP, or the response from the LNP SCP contains a fatal error, the switch shall route the call to the donor switch. In the ensuing ISUP IAM, the _Translated Called Number Indicator_ field of the FCI parameter shall be set to Number Not Translated, and the _Routing Attempt_ indicator shall be set to _no routing attempt in progress._

¥ if the LNP response contains an LRN, the switch shall route the call to the recipient switch. In the ensuing ISUP IAM, the _Translated Called Number Indicator_ field of the FCI parameter shall be set to _Number Translated_, the _Routing Attempt_ indicator shall be set to _no routing attempt in progress_, and a GAP shall identify the ported DN.

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[1] In most cases, an LNP response indicating that the Called DN has not ported implies that the Called DN is vacantÑ because the QoR routing attempt has (generally) already established that the Called DN is not equipped at the donor switch.

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Note that a call to a vacant DN results in two call-setups to the donor switch: the firstÑa QoR routing attempt, and the secondÑa regular call attempt following the LNP query. The second call-setup allows the donor switch to provide special vacant number intercept treatment. The donor switch is deprived of this opportunity during the QoR routing attempt because the *Routing Attempt* indicator in the ISUP IAM FCI coerces the donor switch to release the call

A call to non-ported DN where the QoR routing attempt is blocked before reaching the donor switch (e.g., because of network management code controls at an intermediate switch) also results in two call-setups toward the donor switch. Again, the second call-setup allows the blocking switch to apply treatment locally.

As an objective, the QoR initiating switch shall be able to suppress a second call-setup toward the donor office based on the RELease cause value resulting from the QoR routing attempt (i.e., the cause values that suppress a second call-setup shall be administrable at the QoR-capable switch, and the default set shall be empty). In cases where the second call-setup is suppressed, the QoR switch shall instead clear the call based on the RELease cause value resulting from the QoR routing attempt, following the procedures outlined in GR-317 and GR-444.
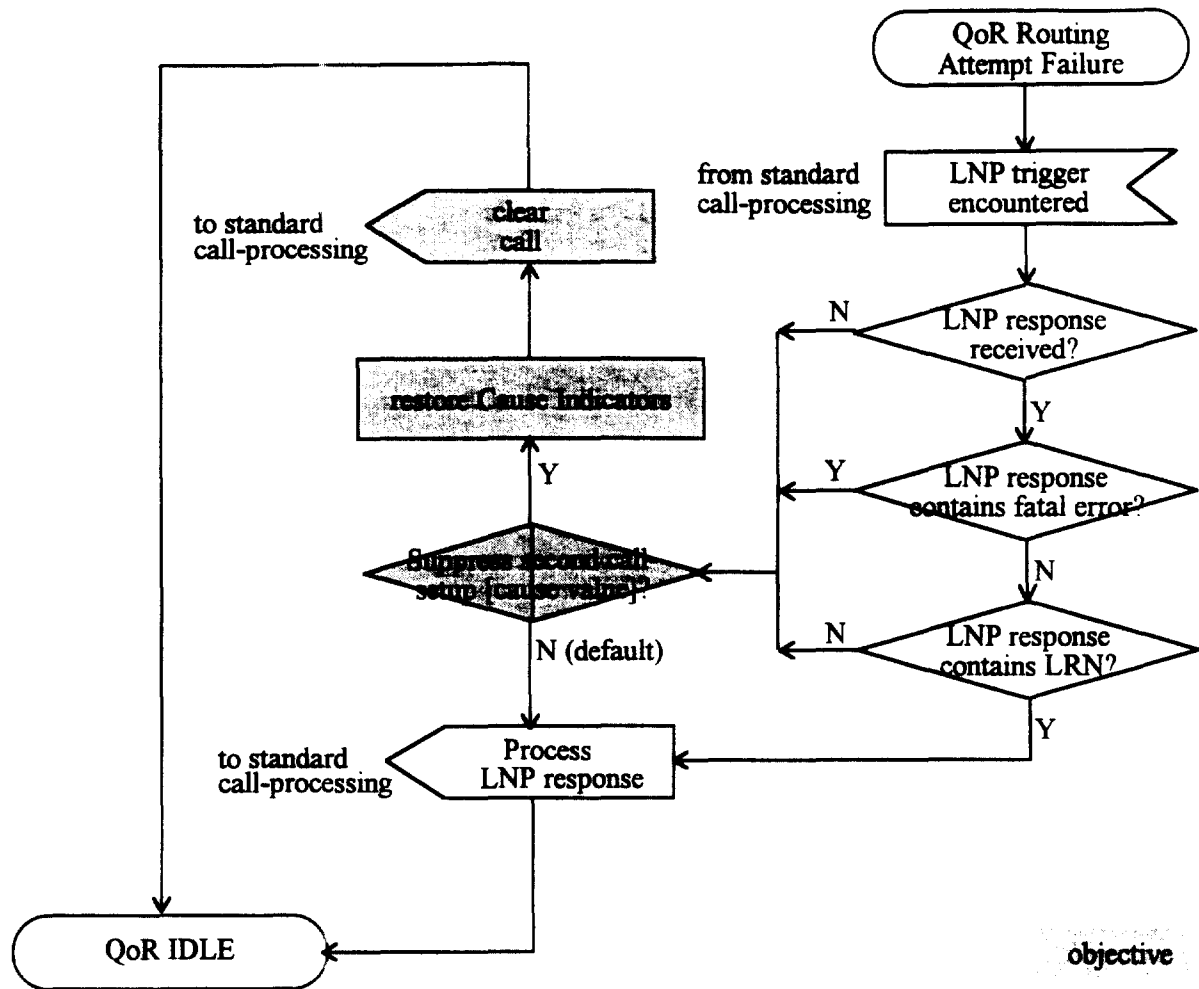
6.0   Feature Operation at Intermediate Switch

An intermediate switch can distinguish a QoR routing attempt from a regular call attempt by examining the *Translated Called Number Indicator* field and the *Routing Attempt* indicator in the ISUP IAM FCI parameter: the intermediate switch shall assume that a QoR routing attempt is underway if

¥ if the *Translated Called Number Indicator* field is set to *Number Translated*, and
¥ the *Routing Attempt* indicator is set to *routing attempt in progress*.

An intermediate switch shall assume that a QoR routing attempt is not underway if the call originates from non-ISUP facilities.

On receipt of a QoR routing attempt, the intermediate switch shall attempt to route the call toward the donor switch. If the intermediate switch is unable to route the call toward the donor switch (because, for example, of network congestion controls, resource

unavailabilities or temporary failures), it shall RELease the call in the backward direction instead of applying treatment locally.

If the intermediate switch delivers the QoR routing attempt to an outgoing ISUP trunk-group that has assigned the signal ported number option, the intermediate switch shall

¥ set the _Translated Called Number Indicator_ field to _Number Not Translated_, and
¥ set the _Routing Attempt_ indicator to _no routing attempt in progress._

If the intermediate switch engages a supplementary service that generates an ISUP ACM or ANM (e.g., an AIN _Send To Resource_ operation) during a QoR routing attempt, it shall reset the _Translated Called Number Indicator_ field and the _Routing Attempt_ indicator to the default values. (Recall that the switch initiating QoR will discontinue QoR on receipt of an ACM or ANMÑ see section 6.4.2.) This will allow the intermediate or a succeeding switch to encounter an LNP trigger or initiate a new QoR routing attempt.

Caution: A QoR routing attempt should not be directed toward an intermediate switch that lacks the software necessary to recognize the new _Routing Attempt_ indicator in the ISUP IAM FCI, unless the switch can be administered to release the ISUP connection by other means if the QoR routing attempt is blocked.

Caution: QoR routing attempts directed to intermediate switches that do not recognize the _Routing Attempt_ indicator may not complete successfully if a supplementary service engaged at the intermediate switch generates an ISUP ACM or ANM.

7.0   Feature Operation at Donor Switch

A donor switch can distinguish a QoR routing attempt from a regular call attempt by examining the _Translated Called Number Indicator_ field and the _Routing Attempt_ indicator in the ISUP IAM FCI parameter: the donor switch shall assume that a QoR routing attempt is underway if

¥ if the _Translated Called Number Indicator_ field is set to _Number Translated,_ and
¥ the _Routing Attempt_ indicator is set to _routing attempt in progress_[2]

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[2] In general, the _Routing Attempt_ indicator will not be set to _routing attempt in progress_ unless the _Translated Called Number Indicator_ field is set to _Number Translated;_ however, a switch with software to manipulate the _Translated Called Number Indicator_ field but not the _Routing Attempt_ indicator may unwittingly introduce a mismatch (e.g., when delivering a call to a trunk-group with the _signal ported number_ option)Ñ for this reason, a switch should ignore the _Routing Attempt_ indicator unless the _Translated Called Number Indicator_ field is set to _Number Translated._

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The donor switch shall assume that a QoR routing attempt is not underway if the call originates from non-ISUP facilities.

On receipt of a QoR routing attempt, the donor switch shall attempt to terminate the call to the DN in the ISUP CdPN parameter. If the called DN is not equipped at the donor switch, it shall RELease the call in the backward direction instead of applying treatment locally.

If the donor switch engages a supplementary service that generates an ISUP ACM or ANM (e.g., an AIN *Send To Resource* operation) during a QoR routing attempt, it shall reset the *Translated Called Number Indicator* field and the *Routing Attempt* indicator to the default values. (Recall that the switch initiating QoR will discontinue QoR on receipt of an ACM or ANM—see section 5.4.2.) This will allow the donor switch to encounter an LNP trigger should the called DN be marked as vacant.

Caution: A QoR routing attempt should not be directed toward a donor switch that lacks the software necessary to recognize the new *Routing Attempt* indicator in the ISUP IAM FCI, unless the switch can be administered to release the ISUP connection by other means if the called DN is marked as vacant.

Caution: QoR routing attempts directed to a donor switch that does not recognize the *Routing Attempt* indicator may not complete successfully if the called DN has ported, and a supplementary service engaged at the donor switch generates an ISUP ACM or ANM.
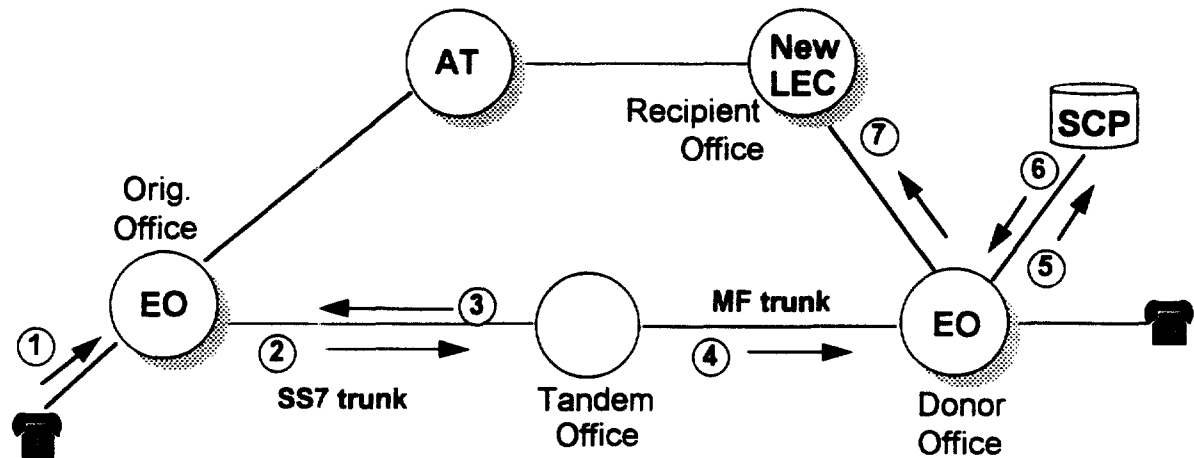
8.0 MF Interworking

QoR routing attempts may encounter MF interworking, in which case an ISUP ACM is sent from the interworking switch to the QoR-initiating switch, causing QoR to terminate.

An LNP-capable switch receiving a routing attempt over MF facilities will recognize it as a call to a portable NPA-NXX. And because Forward Call Indicators (including the *Translated Called Number Indicator* field therein) are not signalled over MF facilities, the LNP-capable switch will either launch an LNP query based on the procedures in FSD-30-12-0001, or initiate a new QoR based on the procedures in this document. (It is assumed that at least one LNP-capable switch will be encountered after MF-interworking, or that the donor switch, if not LNP-capable, will provide some alternative mechanism to reroute calls to DNs that have ported from it).

Caution: Trunk tromboning may result if QoR routing attempts encounter MF interworking.

The network flow for mixed MF and SS7 networking is shown below:

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Figure 2:   ***Network Flow for Mixed MF / SS7 - 1***

For a network scenario with a mixture of MF and SS7 trunks as depicted in Figure 2 above, the call flow would be as follows:

1. The originating switch attempts to set up the call to the donor switch.
2. An IAM is sent to the tandem office via SS7.
3. The tandem office determines that outpulsing will be done on an MF trunk and sends back an ACM to the originating switch. The originating switch then ends the QoR attempt and resumes standard call processing.
4. The tandem outpulses to the donor office over the MF trunk.
5. The donor does not receive the FCI, and therefore sends an LNP query to the SCP.
6. The SCP returns the LRN response.
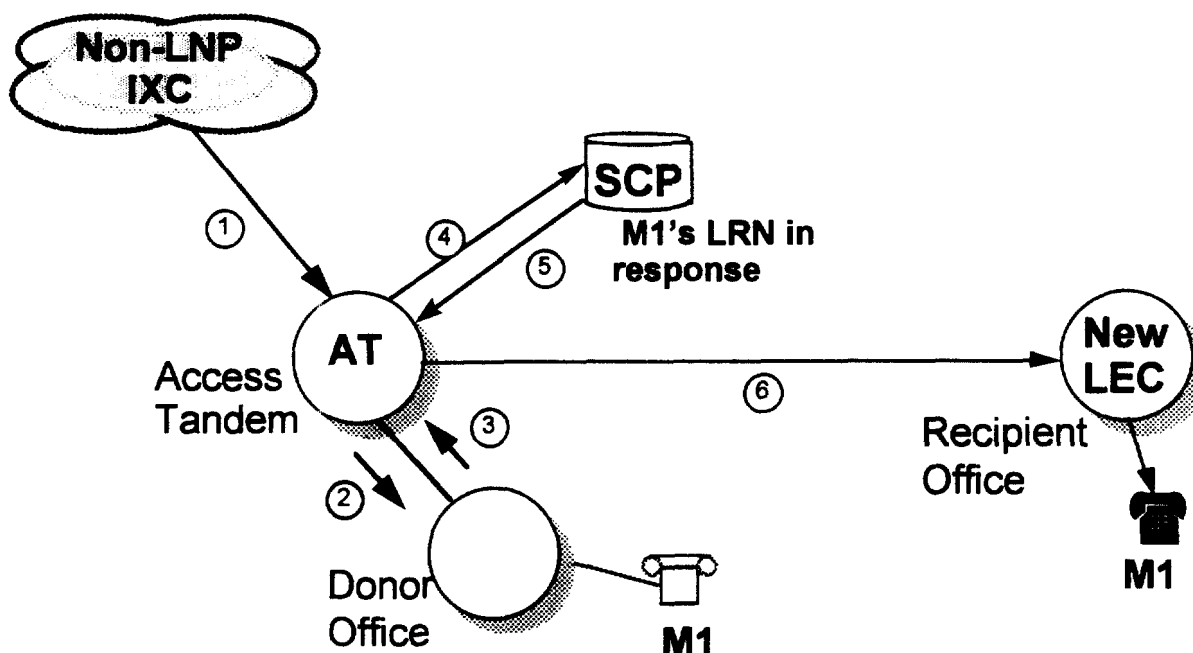7. The donor completes the call to the recipient office.

Figure 3:   ***Network Flow for Mixed MF / SS7 - 2***
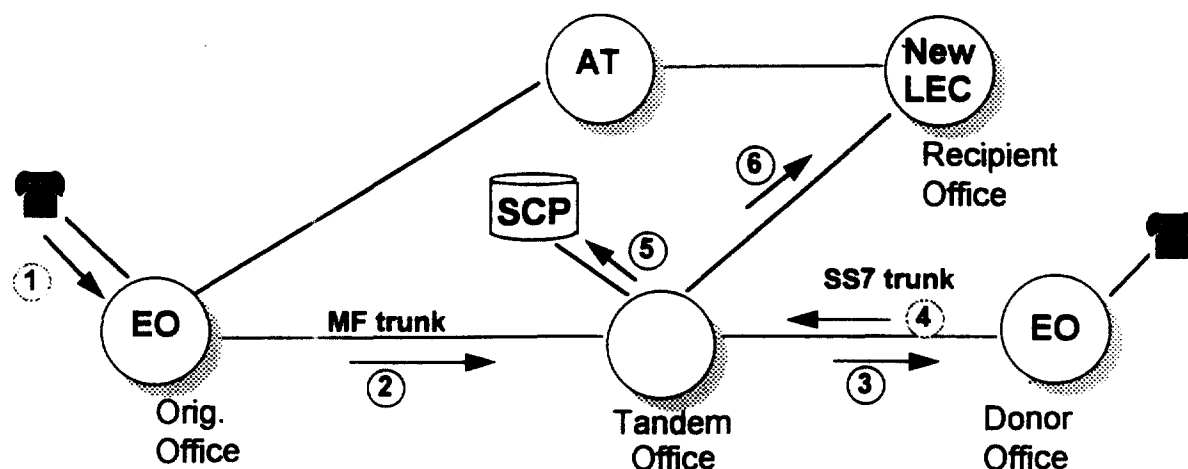
For a network scenario with a mixture of MF and SS7 trunks as depicted in Figure 3 above, the call flow would be as follows:

1. The originating switch attempts to set up the call to the donor switch
2. The originating office outpulses to the tandem office over the MF trunk
3. The tandem does not receive the FCI, so it initiates a QoR operation of its own, based on the dialled number
4. If the DN is ported, the donor responds to the tandem with RELease
5. The tandem responds to the RELease with a query to the SCP
6. The tandem completes the call to the recipient office

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Figure 4:   *Toll Calls from a Non-LNP Capable IXC Switch*

For toll calls from a non-LNP capable IXC switch, the call flow would proceed as follows:

1. An incoming call is initiated from a non-LNP capable IXC to M1
2. The access tandem initiates a Query on Release to the donor switch
3. The donor switch responds with an ISUP RELease with Cause = Unallocated Number
4. The access tandem responds to the RELease message and launches a query the the LNP SCP
5. The SCP provides an LRN response
6. The call is routed to the recipient switch.

9.0   Provisioning

QoR-capable switch:

The following items should be administrable at the QoR-capable switch:

¥ for each portable NPA-NXX, an indication of whether QoR applies;

¥ as an objective, the set of ISUP Cause values that indicate Routing Attempt success (with the default set given in Table 1);

¥ as an objective, the set of ISUP Cause values for which a second call-setup to the donor switch should be suppressed if the LNP query indicates that the called DN has not ported.

Intermediate switch:

QoR does not require special provisioning at intermediate switches equipped with the software necessary to recognize the new *Routing Attempt* indicator.

Intermediate switches that do not recognize the new *Routing Attempt* indicator but receive QoR routing attempts must be provisioned to apply treatments remotely (i.e., send an ISUP REL message) on calls that are blocked because of network management controls, resource unavailabilities or temporary failures.

Donor switch:

QoR does not require special provisioning at donor switches equipped with the software necessary to recognize the new *Routing Attempt* indicator.

Donor switches that do not recognize the new *Routing Attempt* indicator but receive QoR routing attempts must be provisioned to apply treatments remotely (i.e., send an ISUP REL message) on calls that are blocked because of network management controls, resource unavailabilities or temporary failures.

Donor switches that do not recognize the new *Routing Attempt* indicator but receive QoR routing attempts must be provisioned to apply treatments remotely (i.e., send an ISUP REL message) on calls to DNs marked as vacant[3]

10.0   Operational Measurements

The QoR-capable switch shall keep the following traffic measurements:

i) number of QoR routing attempts initiated by this switch;

ii) number of failed QoR routing attempts initiated by this switch (i.e., number of QoR routing attempts that require a subsequent LNP query);

iii) number of QoR routing attempts initiated by this switch that encounter interworking.

---

[3] The donor switch need not RELease the connection if it can determine conclusively that the called DN is vacant as opposed to portedÑin this case, it is more efficient not to force the donor switch to RELease the call, since a second call-setup attempt will ensue. (See section 6.4.3 for more information.)

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As an objective, the switch shall maintain these measurements on a per NPA-NXX (or equivalent) basis.

Additional traffic measurements may be required. Further input from the industry is needed.

11.0   Billing

No QoR-specific billing requirements have been identified in this release of this document. Further input from the industry is needed.

A switch initiating a QoR routing attempt shall follow existing rules governing the generation of switch-based charge and access records. If the QoR routing attempt succeeds, the resulting AMA record shall be indistinguishable from that of a call placed to a DN in a non-portable NPA-NXX.

If the QoR routing attempt fails and an LNP query is undertaken, the switch shall follow the AMA requirements set forth in *FSD 30-12-0001 Generic Switching and Signaling Requirements for Number Portability*. In particular, a terminating LNP AMA module may be appended to the existing switch-based charge or access record associated with the call.

12.0   Feature Interactions

The *Routing Attempt* indicator in the ISUP Forward Call Indicators parameter shall be reset to *no routing attempt in progress* if

¥ the call is redirected because of a switch-based forwarding feature (e.g., call-forward variable, call-forward busy, call-forward no answer); or

¥ the call is redirected because of an SCP-based Analyze Route or Forward Call operation (i.e., one that supplies a new Carrier or Called Party Number parameter); or

¥ the call encounters a supplementary service that generates an ISUP ACM or ANM message (e.g., an AIN Send To Resource operation); or

¥ the call is directed over a trunk-group that has assigned the signal ported number option.

Further investigation is required in this area.

13.0   Signalling Requirements

QoR adds a new Routing Attempt indicator to the ISUP IAM Forward Call Indicators parameter.

H	G	F	E	D	C	B	A
P	O	N	M	L	K	J	I

Bit M: Translated Called Number Indicator
    0Ñnumber not translated
    1Ñnumber translated

Bit N: Routing Attempt indicator

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0Ñno routing attempt in progress
1Ñrouting attempt in progress

Decoupling of the M and N bits is currently under review.

14.0   Issues for Further Study

The following issues remain open:

¥ Is there a need to block QoR routing attempts that cross network boundaries?
What provisioning would be needed at switches to achieve this?
Can this be managed on a per NPA-NXX basis?

15.0   Restrictions and Limitations

QoR is discontinued when a routing attempt encounters MF interworking.

QoR is discontinued when a routing attempt engages a supplementary service that generates an ISUP ACM or ANM.

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16.0 *Glossary and Abbreviations*

ACD	Automatic Call Distribution
ACM	Address Complete Message
AIN	Advanced Intelligent Network
AMA	Automatic Message Account
ANM	ANswer Message
AT	Access Tandem
CFRA	Call Forward Remote Activation
DISA	Direct Inward System Access
DN	Directory Number
Donor Switch	End Office which has had numbers ported from it
DP	Detection Point
EKTS	Electronic Keyset Telephone System
Equipped DN	A DN that is associated with line equipment, an access trunk, an intercept treatment, or with a switch- or SCP-based feature such as AIN 0.0, RCF, DISA, CFRA, MADN, EKTS, UCD, ACD or Hunting.
FCI	Forward Call Indicators
IAM	Initial Address Message
IN	Intelligent Network
Initiating switch	A switch that invokes the QoR capability.
ISDN	Integrated Services Digital Network
ISUP	ISDN User Part
LATA	Local Access and Transport Area
LNP	Local Number Portability
LRN	Location Routing Number
MADN	Multiple Appearance Directory Number
MF	Multi-Frequency
N-1	indicates the next-to-last service provider (e.g., Interexchange Carrier) in a call. Would refer to the originating network if there are only two networks involved.
NPA	Numbering Plan Area

PODP   Public Office Dial Plan

QoR   Query on Release

QoR-capable switch   A switch with the software necessary to perform QoR.

RCF   Remote Call Forwarding

RI   Route index

Routing attempt   The trial termination to the donor switch undertaken by QoR before querying the LNP SCP.

SCP   Service Control Point

TAT   Termination AttempT

UCD   Uniform Call Distribution